

Development of Instrumentation for Direct Validation of Regional Carbon Flux Estimates

Completed Technology Project (2013 - 2014)



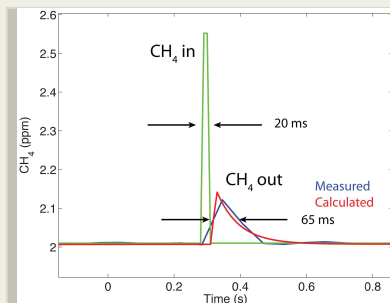
Project Introduction

We are pursuing three tasks under internal research and development: 1) procure a state-of-the-art, commercial instrument for measuring atmospheric methane (CH_4) in situ and modify the analyzer intake flow, temperature, and pressure control systems to achieve sufficiently fast time-response for eddy-covariance flux determination from aircraft; 2) assess the advantages, disadvantages, limitations, and current status of potential greenhouse gas measurement approaches relevant to GSFC development and produce a white paper summary of findings; and 3) write a paper on measurement of GHGs using glint-reflected sunlight and submit it for publication in a refereed journal.

Global distributions of GHG sources and sinks, principally CO_2 and CH_4 , and characterization of the processes that control them, comprise a key uncertainty in projection of future carbon-climate interactions and, hence, climate prediction (US Carbon Cycle Science Plan, 2011; NASA Strategic Plan, 2011). Very little information is available to evaluate global source/sink inversions (e.g., from OCO-2 or the NASA Carbon Monitoring System (CMS)). Bottom up and top down estimates (including forest inventories) don't match well, even for relatively well-sampled areas like North America. Bottom-up vegetation flux models vary widely among themselves, and their response to climate forcing is apparently limited and not adequately tested. Flux tower data are notoriously local site-specific with large spatial variability. Furthermore, requirements for CMS treaty-relevant monitoring, reporting, and validation or Reducing Emissions from Deforestation and Forest Degradation are likely to be extremely stringent compared with current research-level uncertainties and very difficult to quantify on a regional scale. All of this points to an emerging need for NASA to develop a capability for direct validation/evaluation of GHG surface fluxes, which can be most directly obtained regionally via airborne eddy covariance measurements. The principal objective of this project is to assemble an airborne system for direct (eddy covariance) greenhouse gas flux measurements to be used in evaluating top-down and bottom-up source/sink estimates including validation of products from OCO-2 and other space-based GHG missions, biogeophysical models, and application in airborne science campaigns. Here we plan to build and test the first component in this system, a fast-response CH_4 analyzer, which is currently not generally available for use. We also have related objectives to summarize the characteristics of potential GHG space sensor approaches for Goddard and to publish a study of glint sampling for GHG spectra.

Anticipated Benefits

NASA capability for direct validation/evaluation of GHG surface fluxes, which will enable better informed projections of carbon-climate interactions.



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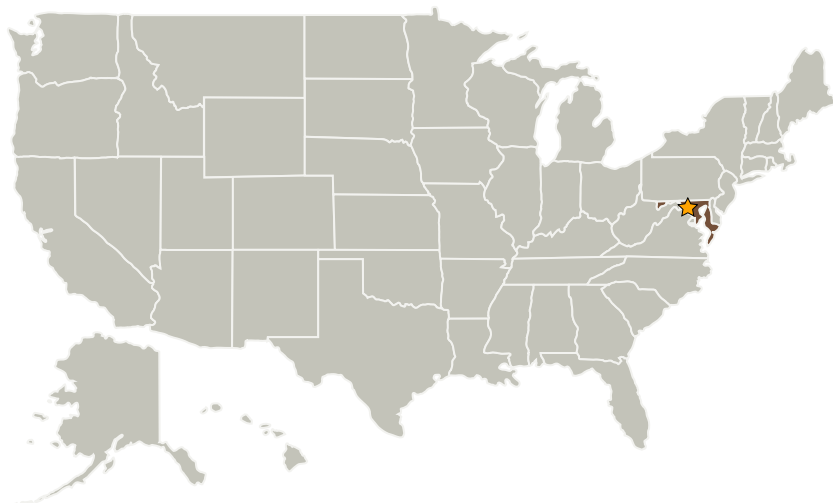
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Goddard Space Flight Center (GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

Matthew J McGill

Principal Investigator:

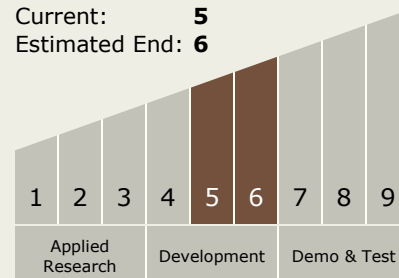
Stephan R Kawa

Technology Maturity (TRL)

Start: 5

Current: 5

Estimated End: 6

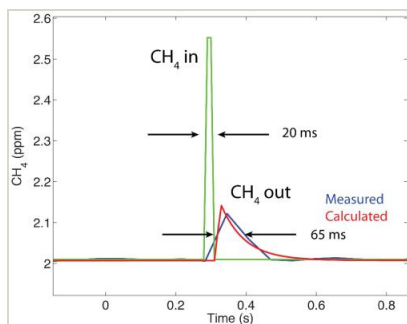


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Images



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Development of Instrumentation for Direct Validation of Regional Carbon Flux Estimates Project
(<https://techport.nasa.gov/image/3999>)

Project Website:

<http://sciences.gsfc.nasa.gov/sed/>

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
 - └ TX09.4 Vehicle Systems
 - └ TX09.4.5 Modeling and Simulation for EDL